G.C.E. A/L Examination March - 2020

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education Northern Province.

FWC

| Chemistry **II - A** | Grade :- 12 (2021) | |

Part – II
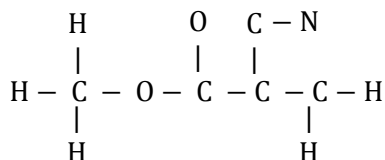### Structure questions - A

❖ **Answer all the questions.**

01. a) Fill in the blanks for the following questions.

(i) Out of the elements N, O, F which element has the highest first ionization energy? ………………………

(ii) Out of the three cations Na^+, Al^{3+}, Ca^{2+} the ion having the smallest ionic radius. ………………………

(iii) Out of the molecules H_2S, SO_2, H_2O which one has the highest bond angle? ………………………

(iv) Of the elements C, S, Br which one has the highest electro negativity? ………………………

(v) Out of Mn, Co^{2+}, Fe^{3+} which ion has five unpaired electrons? ………………………

[05 x 5 = 25 Marks]

b) The following questions are based the molecule methyl 2 – cyanoacrylate [MCA]. Given below it's basic structure.

$$\begin{array}{ccccccc} & H & & O & C-N & & \\ & | & & | & | & & \\ H- & C & -O- & C & -C- & C & -H \\ & | & & & | & & \\ & H & & & H & & \end{array}$$

(i) Draw the most acceptable Lewis structure of the MCA molecule.

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[07 Marks]

(ii) Draw the possible resonance structures of MCA.

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[10 Marks]

(iii) On the basis of the Lewis structures of MCA molecule drawn in (i) above complete the table given below. .

   I.   VSEPR pair around the atom

   II. Geometry of electron pairs around the atom

   III. Shape around the atom

   IV. hybridization of the atom

$$
\begin{array}{c}
\quad\ \ H \qquad\ \ O \quad\ C_4-N \\
\quad\ \ | \qquad\quad | \qquad | \\
H-\ C\ -\ O_1-\ C_2-\ C_3-\ C_5-H \\
\quad\ \ | \qquad\qquad\qquad\quad |\ \\
\quad\ \ H \qquad\qquad\qquad\ H
\end{array}
$$

	O_1	C_2	C_3	C_4
I. VESPR pairs				
II. Geometry of electron pair				
III. shape				
IV. hybridization				

[16 Marks]

(iv) In the Lewis structure given in (i) above identify the atom / hybrid orbitals related to the σ bond formation given below. [as shown in atom number in question (iii)]

   I. $O_1 - C_2$:- O_1 ………………………… C_2 …………………………………

   II. $C_2 - C_3$:- C_2 ………………………… C_3 …………………………………

   III. $C_3 - C_4$:- C_3 ………………………… C_4 …………………………………

   IV. $C_4 - N$:- C_4 …………………………   N …………………………………

   V. $C_3 - C_5$:- C_3 ………………………… C_5 …………………………………

[10 Marks]

(v) Consider the MCA molecule as given below and draw the approximate shape indicating bond angles.

$$
\begin{array}{c}
\qquad\quad O \quad\ CN \\
\qquad\quad | \quad\ \ | \\
CH_3\ -\ O-\ C\ -\ C\ -\ CH_2
\end{array}
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[07 Marks]

c) In the statements given below state whether they are true or false .

    I. NO_2^- is more stable than NO_4^{3-} (………….…)

    II.   Melting point of KI is higher than that of KI   (………….…)

    III. The kinetic energy of particles of ideal gas is directly proportional
          to absolute temperature   (………….…)

    IV. At room temperature entropy of 1 mol CO_2 is higer than that of 1
          mol of water   (………….…)

    V.   All the metals of S- block readily react with water   (………….…)

                                                   [05 x 5 = 25 Marks]

100

02. a) A, B are metals of S – block with water A reacts slowly and B reacts vigorously to produce solutions C and D respectively and a colourless gas E. Both A and B reacted with N_2 gas to produce solids F and G respectively. F and G reacted with water solutions gives C and D respectively and a gas H which changed litmus from red to blue. A and B have the highest and the lowest first ionization energies in their group. These metal A and B produced Crimson red and yellow- green flames in the flame test.

    (i)   Identify A – H and write the formulae

        A - …………………………….   E - …………………………….

        B - …………………………….   F - …………………………….

        C - …………………………….   G - ……………………………..

        D - …………………………….   H - …………………………………

                                                  [02 x 8 = 16 Marks]

    (ii) Write the electro configuration of A in the form $1S^2, 2S^2$…………………….

        A :- ………………………………………………………………………………………………...

                                                   [04 Marks]

    (iii) Write the balanced equation for the reaction of A, B with water (Use real symbols) .

        A : - …………………………………………………………………………………………………...

        B :- …………………………………………………………………………………………………

                                                  [05 x 2 = 10 Marks]

    (iv) Write balanced chemical equations for the reactions of F and G with water

        F : - …………………………………………………………………………………………………...

        G :- …………………………………………………………………………………………………

                                                   [05 x 2 = 10 Marks]

    (v) Write balanced chemical equation for the thermal decomposition of the nitrate of A.

        ………………………………………………………………………………………....................

                                                   [05 Marks]

    (vi) When CO_2 gas is passed through D, white precipitate is obtained. Write balanced equation

        ………………………………………………………………………………………......................

                                                   [05 Marks]

    (vii) Which of the salts of A are insoluble in water?

        …………………………………………………………………………………………………...

                                                   [06 Marks]

(viii) Write the name / s of the group to which A and B belong

   ....

   [04 Marks]

(ix) What is the purpose of using conc. HCl in flame test?

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   [05 Marks]

(x) Some metals / their salts belonging to S – block do not show any colour in flame test state reason.

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   [05 Marks]

(xi) What are the metals that are used for flame test.

   ....

   [05 Marks]

(xii) What would you observe if salts containing same type of cation and different types of anions are used in flame test?

   ....

   [05 Marks]

b) The following compound are contained in test tubes labelled from A to E but not in the order.

   $Pb(NO_3)_2$, $(NH_4)_2CO_3$, $MgSO_4$, $BaCl_2$, Na_2S

   The tests performed on the above compounds to identify them and the observations are given below.

Compound	Test and observation
A	On heating produced three gaseous products
B	With dilute HCl produced a gas with bad odour
C	When $KI_{(aq)}$ added, produced yellow precipitate
D	With both $NaOH_{(aq)}$ and $NH_4OH_{(aq)}$ produced precipitate.
E	No precipitate with $NaOH_{(aq)}$

Identify the compounds from A to E .

   A   - ....   D -................................

   B   -...............................   E -................................

   C   -...............................   .

   [05 x 4 = 20 Marks]

100

03. The apparatus shown in the diagram is used to find the enthalpy of neutralization of NaOH and HCl. At 30^0 C 500 cm^3 of 1 moldm^{-3} HCl solution and 500 cm^3 of 1 moldm^{-3} aqueous solution of NaOH mixed and the temperature of the mixture rose to 36.8^0C. Density of water and the specific heat capacity are $1.00\ gcm^{-3}\ and\ 4.20Jg^{-1}K^{-1}$ respectively.

Thermometer · Glass rod · Beaker · Plastic jar
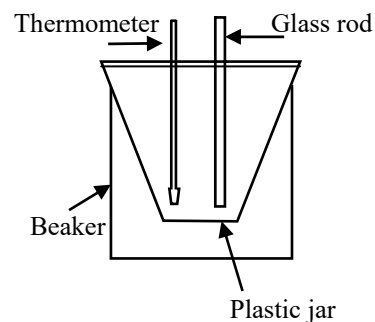
(i) Calculate the heat evolved in the above experiment

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[10 Marks]

(ii) Is the above reaction exothermic or endothermic? Give reason

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[04 Marks]

(iii) What is the number of moles of $H_2O_{(l)}$ produced in the above reaction?

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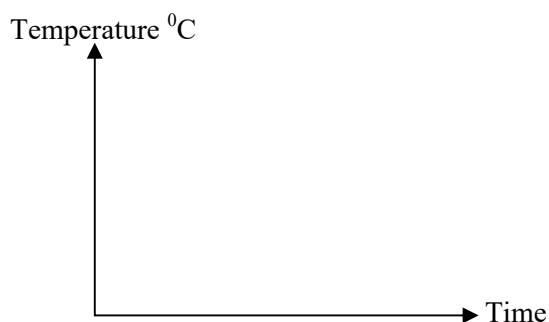
[10 Marks]

(iv) Using the data given in the above experiment. Find the enthalpy change of neutralization of the reaction between NaOH and HCl

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[10 Marks]

(v) By drawing the curve show how the temperature of the system (solution) changes with time .

Note :- Finally the temperature returns to 30^0C

Temperature ^{0}C

Time

[10 Marks]

(vi) Explain, why plastic vessel is used instead of metallic vessel

………..

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………..

[05 Marks]

(vii) At the beginning of the experiment if the initial temperatures of HCl and NaOH are $t_1{}^0C$ and $t_2{}^0C$ respectively, what would be the initial temperature you would use in your calculation

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…….....

[05 Marks]

(viii) State the assumptions you had used in the above experiment

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[06 Marks]

(ix) In the above experiment instead of HCl if CH_3COOH of same volume and concentrations are used will you get the same value you got in (iv) above. state reason.

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[10 Marks]

(x) If the above experiment is done using $500 \, cm^3$ of $0.5 \, moldm^{-3}$ H_2SO_4 and $500 \, cm^3$ of $0.5 \, moldm^{-3}$ $Ba(OH)_2$ will the final temperature be equal / more / less than 36.8^0C. Give reason

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[10 Marks]

(xi) At 30^0C ΔS for the reaction between NaOH and HCl is $80.6\,JK^{-1}mol^{-1}$. Using the enthalpy value obtained in (iv) above, calculate ΔG for the reaction between NaOH and HCl in $kJmol^{-1}$ (at 30^0C)

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[10 Marks]

(xii) When temperature increases, what will happen to the value of ΔG in the initial experiment give reason.

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[10 Marks]

04. a) (i) Write the molecular kinetic equation and identify the symbols

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[10 Marks]

(ii) Using ideal gas equation and the above equation prove that $\sqrt{\overline{C^2}} = \sqrt{\dfrac{3RT}{M}}$ M – molar mass

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[10 Marks]

(iii) Using the above formula at 320 K calculate the root mean square velocity of $O_{2(g)}$ at 320 K (O – 16)

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[05 Marks]

100

(iv) Draw the graph of $\overline{C^2}$ Vs t (K) for the gases $H_{2(g)}, Ne_{(g)}, N_{2(g)}$ [gases behave idealy]

(H – 1, Ne – 20, N – 14)

$\overline{C^2}$

T (K)

[05 Marks]

(v) If the Boyles temperature of A is 30^0C

I. 60^0C II. 30^0C III. 0^0C

For gas A draw the graph of compressibility factor (Z) Vs pressure (P).

Z

P

[10 Marks]

(vi) For a gas, of which, the molar mass is not known, how would you find out, whether the gas deviates from ideal behaviour.

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[10 Marks]

b) (i) Write balanced chemical equations for the following enthalpy changes .

 I. Standard enthalpy of combustion of $C_6H_{6(l)}$

 …………………………………………………………………………………………………...

 II. Standard enthalpy of formation of $C_3H_{8(g)}$

 …………………………………………………………………………………………………..

 III. Standard enthalpy of dissociation of lattice of $Al_2O_{3(s)}$

 …………………………………………………………………………………………………..

 IV. Standard enthalpy of solvation of $NaCl_{(s)}$

 …………………………………………………………………………………………………..

 V. Standard enthalpy of atomization of bromine

 ……………………………………………………………………………………………….......

[25 Marks]

 VI. Draw Born – Haber cycle for the calculation of lattice enthalpy change of $KBr_{(s)}$

[20 Marks]

100

| Chemistry II - B | Grade :- 12 (2021) | |

Part – B

Essay questions

Answer any two questions only. .

05. a)

    I.   What is meant by ideal gas?

    II.   Write Daltons law of partial pressure.

         Obtain this law from ideal gas equation

    III. Give two reasons for the deviation of real gases from ideal behavior

  b)

$He_{(g)}$
27^0C
$4.157 \ dm^3$
4g

Valve

$Ne_{(g)}$
127^0C
$8.314 \ dm^3$
40 g

A

B
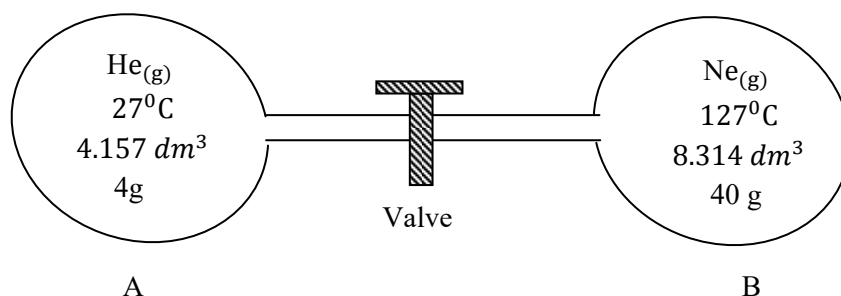
As shown in the above diagram. He and Ne gases are in rigid flasks A and B. Initially they are connected using tubes of negligible volumes and the valve is closed. Then the valve is opened and the gases allowed to mix . (He – 4 , Ne – 20)

    I. Find the number of moles of the gases.

    II. Find the pressures of the gases before opening the valve.

    III. After opening the vale, assuming that there is no change in the temperature, find the pressure of the system

    IV. After opening the valve and assuming that the temperature of the system is 27^0C , Find the molar mass of the gaseous mixture .

    V. From part (IV) above, Find the density of the gaseous mixture at 27^0C.

  c) I. What is a closed system

     II. Write the definitions of the following

        (i)   Standard enthalpy change of bond dissociation.

        (ii)   Standard enthalpy change of hydration.

III. Using the thermo chemical data given below, find ΔH_{rxn}^{θ} of

$$C_2H_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(l)}$$
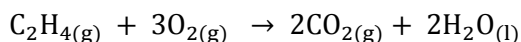
Following are the standard enthalpy of bond dissociation

$O = O : 495$ kJmol^{-1} C - H : 412 kJmol^{-1}

$C = C : 610$ kJmol^{-1} $O - H : 460$ kJmol^{-1}

$C = O : 750$ kJmol^{-1} $\Delta H_{evap}^{\theta}(H_2O_{(l)}) = 41$ kJmol^{-1}

06. a) X is an element belonging to the 3rd period. X reacts separately with aqueous KOH and aqueous HCl to produce gas Y. X reacts with Y to produce a strongly basic ion solid P. P reacts with water to produce a gas Y and a clear solution Z. When ignited in atmosphere X is capable of producing two products R and Q

     I.   Identify X and Y

     II.   Identify P, Q and R

     III.   Write balanced equation for the reactions of X with aqueous KOH and aqueous HCl

     IV.   Write balanced equation for the reaction of P with water,

     V.   Write equation for the reaction of Z with CO_2 and also the equation for the reaction with excess CO_2.

     VI.   Out of the compounds that are formed containing X in the reaction in (V), which one is more soluble?

     VII.   When aqueous $MgCl_2$ is added to Z what would you observe? Give equation for that reaction?

     VIII. State one natural occurrence of X.

     IX.   Give one use of X.

     X.   With reason explain the tendency of the thermal decomposition of the nitrates of the elements belonging to the group to which X belongs to.

b) 100 cm^3 of 0.3 $moldm^{-3}$ $Na_2C_2O_4$ is added to 5.881g of solid $K_2Cr_2O_7$ in acidic medium. Based on this answer the following questions. (K- 39, Cr – 52, O- 16)

     I.   Half ionic equations for oxidation and reduction

     II.   Complete ionic equation

     III.   Limiting reactant

     IV.   Number of moles of . CO_2 produced

     V.   Volume of CO_2 at STP. (at STP 1mol of CO_2 occupies 22.414 dm^3)

c) Give IUPAC names of the following compounds. .

     I. $CuCl_2$ II. N_2O_4

     III. HBr   IV. $HClO_4$

07. a) I. $NaCl_{(s)}$ and $KCl_{(s)}$ are in different test tubes. State an experiment to differentiate them.

Conc. HCl is the only chemical provided. The other laboratory facilities are available.

II. Give one experiment to find the tendency of the solubility of the carbonates of the elements in the 2nd group.

III. State the oxides formed by the elements C, N, P, S and indicates their acidic / basic characters.

b) M is a transition element belonging to 3d series. This element contains six unpaired electrons in the ground state

I. Identify M

II. Write the electronic configuration of M

III. State the oxides formed by M and indicate their acidic, basic characters.

IV. When $NaOH_{(aq)}$ is added to $M^{3+}_{(aq)}$ dropwise state the colour changes and indicate the formula of compounds responsible for these colours.

V. State the observation you obtain when H_2O_2 is added to the precipitate formed by the addition of aqueous NaOH to M^{3+} solution and write equation for this change. (Basic medium)

VI. From the above (v) solution what do you observe when adding the acid and give the reaction for the observation?

VII. Give one usage of M?

c) At 100^0C and 1 atm 2 mol of $H_{2(g)}$ and 1 mol $O_{2(g)}$ react to form 2 mol $H_2O_{(g)}$ releasing 484 kJ

I. Find the enthalpy change of the reaction.

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)} \quad \text{(reaction I)}$$

II. At 100^0C if the entropy of $H_{2(g)}$, $O_{2(g)}, H_2O_{(g)}$ are 130 J mol^{-1}K^{-1}, 205 J mol^{-1}K^{-1}, 190 J mol^{-1}K^{-1} respectively calculate the entropy change of reaction (I)

III. Find ΔG of reaction (I) at 100^0C

IV. Will reaction (I) take place spontaneously at 100^0C Give reason.